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Evaluating cardiovascular disease risk in type 2 diabetes mellitus patients in a tertiary care hospital in Hyderabad, Sindh, Pakistan

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Abstract: Type 2 Diabetes Mellitus (DM) is the most common type of diabetes. The main adverse effect of diabetes type 2 involves a higher risk of cardiovascular disease. Diabetes patients with this type are more likely to suffer cardiovascular problems. Consequently, this study investigated demographics, CVR factors, age, gender, physical activity, BMI, hemodynamics, HbA1c stage, and lipid profile of 120 patients with type 2 diabetes in Hyderabad, Sindh, Pakistan. The study covered 120 patients with type 2 diabetes, out of which 40 were male (33.3%) and 80 were female (66.6%), aged 50 to 70. Out of these 120 patients, 17 (14.1%) had coronary artery disease, 15 (12.5) had atherosclerosis, and 8% (6.6) experienced a stroke, according to the findings. Approximately 37.5% of patients had overweight obesity, 54% had poor diabetes control, and 10% had reasonable control based on their HbA1c readings. Furthermore, 55% were hypertensive, and around 12.5% had both macro and microvascular problems. In general, around 33.3% of all Type 2 DM patients have cardiovascular diseases (CVD), indicating that patients with Type 2 DM have a greater risk of increasing CVD. As a result, proper strategies should be implemented to avoid catastrophic outcomes and disease development.

Keywords: Diabetes mellitus, Diabetes type 2, Hemodynamic measurement, Glycosylated haemoglobin, Cardiovascular disease, Coronary artery disease, Atherosclerosis.

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1. Introduction

Type 2 diabetes, commonly known as Diabetes Mellitus (MD), is a chorionic metabolic disorder characterized by abnormalities in insulin synthesis, motility, or both (Whiting *et al*., 2011). These abnormalities lead to hyperglycaemia and disturbances in the metabolism of carbohydrates, fats, and proteins. According to Zhang *et al.* (2010), the global prevalence among adults is growing, estimated to be 6.4% in 2010 and will grow up to 7.7% in 2023. Similarly, according to International Diabetes Federation 8.8% of the total population worldwide is estimated to have diabetes, and 642 million cases worldwide are expected by 2040. The advantages of type 2 diabetes have gradually increased in recent years. The use of facts from the Framingham heart study takes a look at Abraham *et al.* (2015), it is reported that the general annualized prevalence charges of the ailment consistent with 1000 folks expanded from 3.0 in the Nineteen Seventies to 5.0 within the first period of the 2000s, which exchanged, represented, and flourished inside the prevalence of Type 2 DM of 83.3% and was better in adult males than girls using an aspect of 1.61%.

Cardiovascular Diseases (CVDs) is a major motive of death and incapacity among human beings with diabetes (International Diabetes Federation, 2016). A near-strong link exists between DM and cardiovascular disorder. According to Low Wang *et al.* (2016), CVD is the most established purpose of mortality and morbidity in diabetic populations. People with Type 2 DM are disproportionately laid low with CVD compared with non-diabetic patients Hanker and Giammara (1988). suggested death charges because of cardiovascular reasons over a 7-12 month length in sufferers with and without Type 2 DM. In individuals with Type 2 DM, the loss of life charges was 15.4% for those with no earlier Myocardial Infarction (MI) and 42.0% for sufferers having a record of MI. In comparison, for patients who no longer have Type 2 DM, the loss of life due to cardiovascular causes had been 2.1 and 15.9%, respectively (Haffner *et al.*, 1998). Other variables associated with DM include obesity, ethnic background, hypertension, and hyperlipidaemia during gestational diabetes (Bjørnholt *et al.*, 2000; Bennett 2004).

Because of substantial obesity, hypertension may be a precursor to insulin resistance. The idea that high blood pressure is a sign of endothelial dysfunction—a risk factor for insulin resistance, type 2 diabetes, and CVDs—is a secondary hypothesis (Tooke & Goh, 1999). According to Hill *et al.* (2003), seventy percent of patients with diabetes have hypertension, and those with hypertension have a double-increased risk of getting DM. Patients diagnosed with type 2 diabetes have a 2-to-4-fold increased risk of developing coronary artery diseases (CADs) compared to those without the disease (Evans *et al.*, 1999). According to American Diabetes Association (2004), for patients with type 2 diabetes, increased levels of triglycerides and lower levels of HDL cholesterol represent the most common type of dyslipidaemia. Given DM's increasing prevalence and financial burden, proper management and treatment are essential. The primary goal of diabetes treatment must be to lower the Cardiovascular (CV) risk of diabetic patients since CVD is the most common cause of death and morbidity in DM patients.

Research has suggested that numerous elements, including elevated oxidative strain, improved coagulability, endothelial disorder, and autonomic neuropathy, are regularly found in sufferers with DM and can immediately contribute to improving CVD (Matheus *et al.*, 2013). In 2007, more than one hundred ten million people in Asia have been residing with diabetes, with a very

high disorder load for most of the young. The young age of onset and long-distance duration put Asians with diabetes at high hazard for cardiorenal disorders. According to GU *et al*. (1999), CVD brings about widespread morbidity, growth mortality, and burden on fitness care infrastructure. Pakistan, with a population of approximately 199 million projected population based on census figures, has an envisioned diabetes prevalence of 11.4% in the age institution of 25 years and above. Studies from Pakistan have discovered the persistent complications of diabetes, together with CVD (Kharal *et al*., 2010; Aldiab *et al*., 2018). The current study aimed to determine the prevalence of cardiovascular risk in patients with type 2 diabetes mellitus in Hyderabad, Pakistan. The results of this analysis could be applied to identify more targeted strategies to lower the cardiovascular diseases in type 2 diabetes patients.

2. Materials and method

The current study was conducted in Hyderabad, Sindh, Pakistan at a tertiary hospital. From February to August of 2023, the OPD of the hospital conducted a routine visit to the (diabetic and cardiac) ward in Civil Hospital, Hyderabad, Sindh where data on Type 2 DM patients were collected.

2.1. Questionnaire data

Data was collected using a self-developed questionnaire in English. Verbal consent was obtained from patients with CVDs and type 2 diabetes mellitus (T2DM). Pre-designed remarks regarding CVD were recorded by asking questions to medical outpatients at the hospital. All interviewers had been trained and performed the questionnaire surveys in step with a prescribed method. The questionnaire consists of the individual's demographics and clinical traits along with gender, age, education level, residence, hypertension, dyslipidaemia, the measurement of Body Mass Index (BMI), pulse rate, blood pressure levels (systolic and diastolic, and family history of cardiovascular diseases, and physical inactivity.

2.2. Study participants

Patients with Type 2 DM and CVD from the previously mentioned hospital were investigated in two different age groups in February and August of 2023, and a thorough medical history was requested. We examined blood pressure, blood sugar, length of disease, and cardiovascular risk factors (dyslipidaemia, central obesity) in patients with type 2 diabetes. We also examined family history information related to CVD.

2.3. Physical examination

The height and weight were measured using the Body Mass Index (BMI) formula (kg/m^2). An individual's body weight in kilograms divided by their height in meters square is now used to compute their BMI. The findings were divided into three groups: obese (≥30.0), overweight (25.0 - 29.9), and normal (18.5 - 24.9). The results were categorized into three groups: normal (18.5 - 24.9), overweight (25.0 - 29.9), and obese (≥30.0) by Kharal *et al.* (2010). The resting systolic and diastolic pressures were measured two times with an interval of at least five minutes with the aid of an automatic sphygmomanometer. Blood pressure readings were classified as normal (less than 120/80 mmHg), pre-hypertension (between 120/80 and 140/90 mmHg) and hypertension (more than 140/90 mmHg) by Aldiab *et al.* (2018).

The blood glucose level was measured using an automatic glucometer. Glycosylated Haemoglobin (HbA1C) and Fasting Blood Glucose (FBG) were used to assess the state of glucose management. Based on their FBG, patients were categorized as having poor control (>130 mg/dl) or normal control (≤130 mg/dl) by Kamuhabwa and Charles (2014). The haemoglobin A1C level was used to divide the study participants into three groups. Patients in Group 1 demonstrated good control (<7%); those in Group 2 showed acceptable control (between 7-8%); and those in Group 3 demonstrated poor control (>8%). Glycosylated haemoglobin (HbA1C) and FBG were used to assess the state of glucose management. The study participants were categorized into three groups based on the level of haemoglobin A1c. Patients in Group 1 had good control (<7%); patients in Group 2 had fair control (between 7-8%); and patients in Group 3 had poor control (>8%) Afroz *et al.* (2019).

4. Results and discussion

There were 120 CVD patients with Type 2 DM who received medical care in total. The total four different age groups were selected i.e. (40-50, 51-60, 61-70, and 70-80). The maximum number of cardiovascular visits in diabetic type 2 found at the age of 41 to 60. In total 80 were female with 66.66%, and male 40 with 33.33% surveyed from Civil Hospital Hyderabad Sindh. Overall, 33.33% of people with type 2 diabetes had CVD, according to studies that reported prevalence rates for both genders combined. The two most common co-morbidities associated with CVD were atherosclerosis and CAD, with prevalence rates of 12.5% and 14.1%, respectively. On the other hand, STROKE had a 5.8% frequency rate, making it less common. About 12.5% of the study subjects had both macro and microvascular complications. With this, 37.5% were obese. Based on Hb1Ac numbers, 54% of patients had poorly controlled diabetes despite 10% having fair management. In addition, 55% had high blood pressure. Diabetes mellitus 2 is a chronic disease associated with devastating complications generated by endothelial alterations at different vascular levels, hyperglycaemia, hypertension, dyslipidaemia, Obesity, physical inactivity, and smoking have been identified as the main risk factors for endothelial dysfunction, and vascular and macro vascular complications, specifically atherosclerosis cardiovascular disease (CV disease), which includes CVD, chronic peripheral artery disease, and cerebrovascular disease (Roman & Stoian, 2021).

For haemoglobin that is older than a period of three months, Hb1Ac is widely recognized for its glycaemic index. In our examination, 54% of the members had poor control of HbA1c, even as 10% had fair HbA1c management. HbA1c degree changed drastically greater in members with higher SBP (mmHg), PP (mmHg), and extreme BMI, which is similar to Husein *et al*. (2020) results who had out-of-control HbA1c. Alghamdi *et al*. (2021) discovered that an increase in HbA1c concentration was linked to a higher risk of death as well as a larger hazard for macrovascular and combined vascular events (22). Additionally, Peng *et al.* (2013) reported that only 22% of the study subjects in our study were in fair control of their HbA1c level. Therefore, maintaining HbA1c levels at or below 7% is vitally important (Hussein *et al*., 2020).

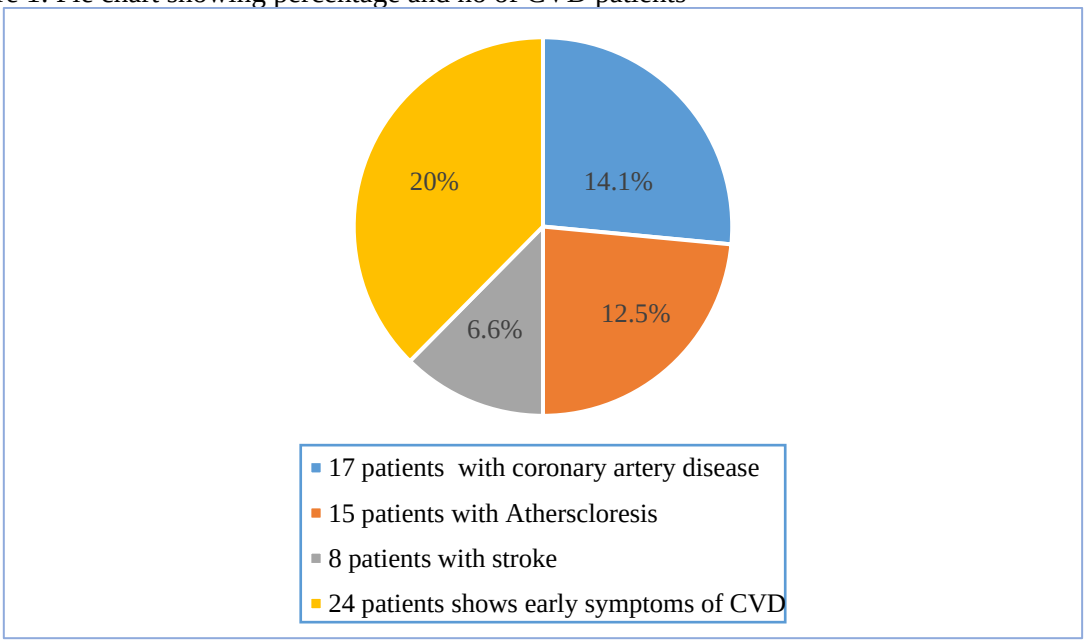
Table-1: Showing cardiovascular disease with subject numbers

S. No	CV- Risk Factors	N = 40
1.	Coronary artery disease	17
2.	Atherosclerosis	15
3.	STROKE	8

We also found a significant affiliation between excessive BP and high HbA1c. The advantageous affiliation between these two was also observed in numerous other studies. This association is likely due to the shared risk factors and inflammatory processes observed in both hyperglycaemia and hypertension (Ahmed *et al.*, 2013; Alghamdi *et al.* 2021). 55% of diabetic patients in the current research reported uncontrolled blood pressure, which is comparable to the number reported in several foreign studies, which were estimated to be 60.25%, 74.5%, and 77.6% in Egypt, North Carolina, and Sri Lanka, respectively (Ahmed e*t al.*, 2013; Savoia & Schiffri, 2007; Jurado *et al.*, 2009).

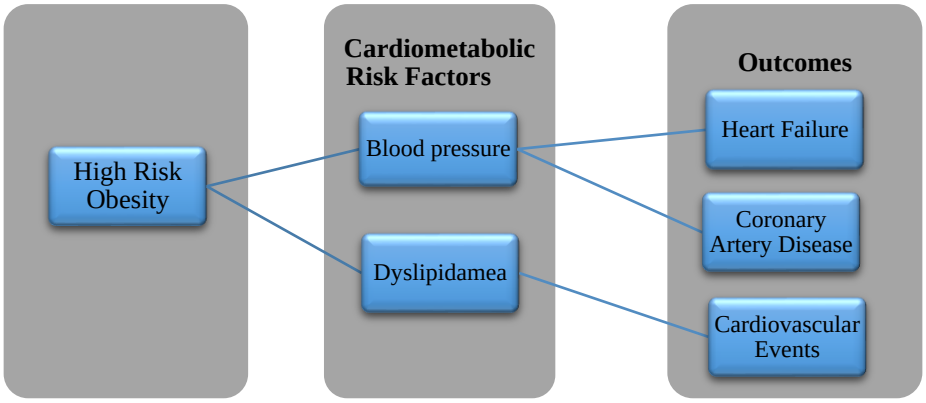
Additionally, one significant aspect of diabetes is dyslipidaemia, characterized by elevated levels of triglycerides and Low-Density Lipoprotein (LDL), along with decreased levels of High-Density Lipoprotein Cholesterol (HDL-C) (Arambewela *et al.*, 2018). The primary mechanism behind the development of dyslipidaemia in individuals with diabetes is insulin resistance. The release of free fatty acids from adipose tissue contributes to peripheral insulin resistance, which subsequently leads to increased uptake by the liver. This process enhances the synthesis of Triglycerides (TG) in hepatic cells (Schofield *et al.*, 2016). TG containing high LDL molecules facilitate the production of small, dense LDL particles as they are hydrolysed by lipoprotein lipase. This underlying pathophysiology of dyslipidaemia elevates the risk of CVD in individuals with diabetes.

Figure 1: Pie chart showing percentage and no of CVD patients



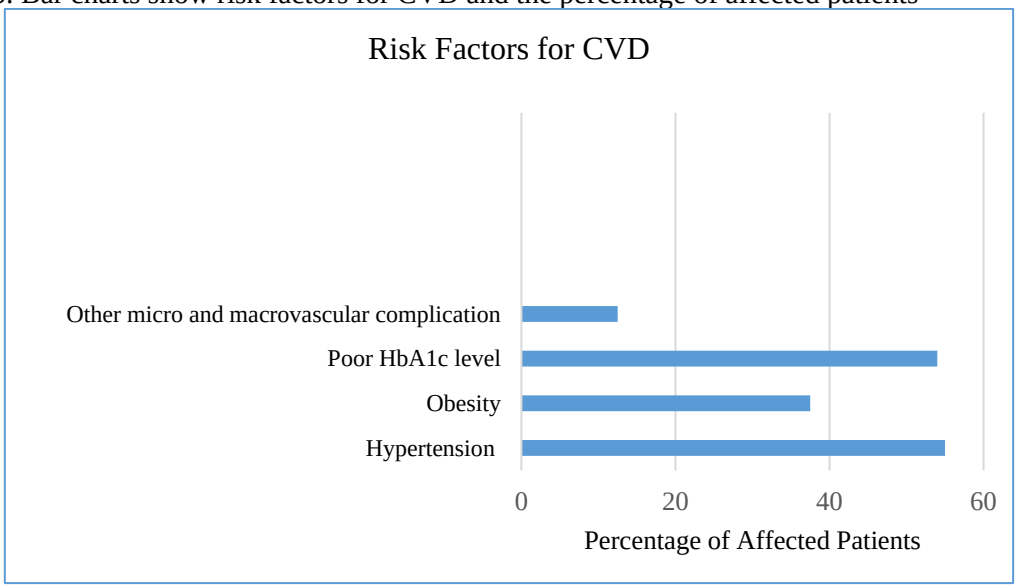
Obesity complications have long been established as an independent risk element for CVD (Bays *et al.*, 2016; Fox *et al.*, 2008) and are associated with CAD (Hubert *et al.*, 1983; Rabkin *et al.*, 1977), atherosclerosis (Garcia- Labbé *et al.*, 2015), and cardiac mortality rate (Rossi *et al.*, 2015; Plourde *et al.*, 2015). Furthermore, it has been shown that overweight and obesity are exceedingly prevalent in Type 2 DM patients with excessive CV risk and that BMI is associated with the major cardiometabolic danger elements together with hypertension and elevated low-density lipoprotein LDL cholesterol (Engeland *et al.*, 2003). In our study, 37.5% of patients were obese. These findings can be defined by visceral fat accumulation that booms insulin resistance, resulting in diabetes Ahmed *et al.* (2013).

Figure 2: Relationship between intermediate cardiometabolic risk factors, higher-risk obesity, and cardiovascular outcomes (obesity phenotypes, diabetes, and cardiovascular disease).



Similarly in this study, the prevalence of cardiac risk in type 2 DM was 33.3%, similar to the 32.2% incidence of CV risk reported in the previous survey. The two most common types of CVD that were documented were atherosclerosis (12.5%) and CAD (14.1%). The STROKE was the less frequent, with a prevalence of 6.6%. With this, males had higher rates of predominant STROKE than females. Several other studies more revealed that patients with Type 2 DM had a similar incidence of cardiovascular risk. Furthermore, a different study carried out in Iran and South Korea found that the prevalence rates of CVD were 37.4% and 26%, respectively. In the study conducted by Liu *et al*. (2010), in China, the prevalence was reported 30.1. In addition to this, in another study conducted in South Korea and Iran, the prevalence rate of CVD was 26% and 37.4%, respectively Liu *et al*. (2010).

Figure 3: Bar charts show risk factors for CVD and the percentage of affected patients



5. Conclusion

The observation indicates a significant occurrence of cardiovascular problems in our study from Hyderabad and adjoining areas. The prevalence of cardiovascular diseases (CVD) in Type 2 Diabetes Mellitus (DM) patients was highly associated with obesity, hypertension, duration of diabetes, physically inactive, poor control of HbA1C, and dyslipidaemia. It is impossible to

overlook the connection between inadequate DM-II management and modifiable CV risk variables. Therefore, proper strategies and treatment should be taken to control CV risk in type 2 DM patients. In future, prevalence-based studies should be conducted across Pakistan's other cities and provinces to identify the cardiovascular risk factors associated with those who have type 2 diabetes. Cardiovascular risks such as alcohol intake, compliance with medications, and socioeconomic status were not taken into account during our investigations.

Declaration of conflict of interest

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References

Adil, M. A., Abbas, A., Ehsan, M., Shah, M., Naqvi, N. A., & Alie, A. (2021a). Investigation of ionospheric and atmospheric anomalies associated with three Mw> 6.5 EQs in New Zealand. *Journal of Geodynamics*, *145*, 101841. https://doi.org/10.1016/j.jog.2021.101841

Adil, M. A., Şentürk, E., Shah, M., Naqvi, N. A., Saqib, M., & Abbasi, A. R. (2021b). Atmospheric and ionospheric disturbances associated with the M> 6 earthquakes in the East Asian sector: A case study of two consecutive earthquakes in Taiwan. *Journal of Asian Earth Sciences*, *220*, 104918. https://doi.org/10.1016/j.jseaes.2021.104918

Adil, M. A., Senturk, E., Pulinets, S. A., & Amory-Mazaudier, C. (2021c). A lithosphere–atmosphere–ionosphere coupling phenomenon observed before M 7.7 Jamaica Earthquake. *Pure and Applied Geophysics*, *178*, 3869–3886. https://link.springer.com/article/10.1007/s00024-021-02867-z

Afroz A., Ali, L., Karim, M.N., Alramadan, M. J., Alam, K., Magliano, D.J, & Billah, B. (2019). Glycaemic control for people with type 2 diabetes mellitus in Bangladesh - an urgent need for optimization of the management plan. *Sci Rep. 9*, 10248. https://doi.org/10.1038/s41598-019-46766-9

Aldiab, A., Shubair, M. M., & Al-Zahrani, J. (2018). Prevalence of hypertension and prehypertension and its associated cardioembolic risk factors; a population-based cross-sectional study in Alkharj, Saudi Arabia. *BMC Public Health, 18*, 1327. https://doi.org/10.1186/s12889-018-6216-9

Denisenko, A., & Zeng, Z. (2020). The analysis of earthquake precursors in variations of TEC in the ionosphere and the subsequent impact on the environment. In *IOP Conference Series: Earth and Environmental Science* (Vol. 421, No. 2, p. 022034). IOP Publishing. https://iopscience.iop.org/article/10.1088/1755-1315/421/2/022034/meta

Fuying, Z., Yun, W., Yiyan, Z., & Jian, L. (2011). A statistical investigation of pre-earthquake ionospheric TEC anomalies. *Geodesy and Geodynamics*, *2*(1), 61–65. https://doi.org/10.3724/SP.J.1246.2011.00061

Hanker, J. S. & Giammara, B. L. (1988). Biomaterials and Biomedical Devices. *Science, 242*(4880), 885-892. https://doi.org/10.1126/science.3055300

Jin, S., & Jin, R. (2014, August). TEC anomalies following the 11 March 2011 Tohoku earthquake observed by a dense GPS array. In *2014 XXXIth URSI General Assembly and Scientific Symposium (URSI GASS)* (pp. 1-4). IEEE. https://doi.org/10.1109/URSIGASS.2014.6929812

Kamuhabwa, A. R., & Charles, E. (2014). Predictors of poor glycemic control in type 2 diabetic patients attending public hospitals in Dar es Salaam. *Drug Healthcare and Patient Safety*, 6, 155-65. https://doi.org/10.2147/DHPS.S68786

Kharal M, Al-Hajjaj A, Al-Ammri M, Al-Mardawi G, Tamim HM, Salih SB, & Yousuf, (2010). M: Meeting the American Diabetic Association standards of diabetic care. *Saudi J Kidney Dis Transpl. 21*, 678-85.

Kiyani, A., Shah, M., Ahmed, A., Shah, H. H., Hameed, S., Adil, M. A., & Naqvi, N. A. (2020). Seismo ionospheric anomalies possibly associated with the 2018 Mw 8.2 Fiji earthquake detected with GNSS TEC. *Journal of Geodynamics*, *140*, 101782. https://doi.org/10.1016/j.jog.2020.101782

Masci, F., Thomas, J. N., Villani, F., Secan, J. A., & Rivera, N. (2015). On the onset of ionospheric precursors 40 min before strong earthquakes. *Journal of Geophysical Research: Space Physics*, *120*(2), 1383-1393. https://doi.org/10.1002/2014JA020822

Pulinets, S. A., Ouzounov, D. P., Karelin, A. V., & Davidenko, D. V. (2015). Physical bases of the generation of short-term earthquake precursors: A complex model of ionization-induced geophysical processes in the lithosphere-atmosphere-ionosphere-magnetosphere system. *Geomagnetism and Aeronomy*, *55*, 521-538. https://link.springer.com/article/10.1134/S0016793215040131

Rahman, Z. U. (2020). Possible seismo ionospheric anomalies before the 2016 Mw 7.6 Chile earthquake from GPS TEC, GIM TEC and Swarm Satellites. *Natural and Applied Sciences International Journal (NASIJ)*, *1*(1), 11–20. https://doi.org/10.47264/idea.nasij/1.1.2

Shah, M., Aibar, A. C., Tariq, M. A., Ahmed, J., & Ahmed, A. (2020). Possible ionosphere and atmosphere precursory analysis related to Mw> 6.0 earthquakes in Japan. *Remote Sensing of Environment*, *239*, 111620. https://doi.org/10.1016/j.rse.2019.111620

Ulukavak, M., & Inyurt, S. (2020). Detection of possible ionospheric precursor caused by Papua New Guinea earthquake (Mw 7.5). *Environmental monitoring and assessment*, *192*, 1–15. https://link.springer.com/article/10.1007/s10661-020-8146-0

Yao, Y., Chen, P., Wu, H., Zhang, S., & Peng, W. (2012). Analysis of ionospheric anomalies before the 2011 M w 9.0 Japan earthquake. *Chinese Science Bulletin*, *57*, 500–510. https://link.springer.com/article/10.1007/s11434-011-4851-y